REMARKS

Prior to the present response, claims 1-8 and 21-30 were pending in the present application. By the present amendment and response, claims 1-2, 21-22, and 29 have been amended to overcome the Examiner's objections. Thus, claims 1-8 and 21-30 remain in the present application. Reconsideration and allowance of pending claims 1-8 and 21-30 in view of the above amendments and the following remarks are requested.

A. Rejection of Claims 1-8 and 29-30 under 35 USC §102(e)

The Examiner has rejected claims 1-8 and 29-30 under 35 USC §102(e) as being anticipated by U.S. patent number 6,184,121 B1 to Buchwalter et al. (hereinafter "Buchwalter"). For the reasons discussed below, Applicants respectfully submits that the present invention, as defined by amended independent claims 1 and 29, is patentably distinguishable over Buchwalter.

The present invention, as defined by amended independent claim 1, recites, among other things, forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, and etching one or more air trenches into damascene structure so that the air trenches are positioned over selected metal lines, wherein the one or more air trenches are not etched into the first dielectric layer and a first capping layer. As disclosed in the present application, a first dielectric layer and a first capping layer are sequentially deposited over a substrate and trenches are etched in the first dielectric layer and the first

capping layer. As disclosed in the present application, metal lines are formed by filling the trenches with a metal such as copper or aluminum.

As disclosed in the present application, in one embodiment, a second capping layer is formed on the first capping layer and a second dielectric layer is formed on the second capping layer. As disclosed in the present application, in one embodiment, air gaps (i.e. air trenches) are formed in the second dielectric layer over selected metal lines. However, the air caps are not formed between the metal lines and, therefore, do not extend into the first dielectric layer and the first capping layer. By forming air gaps in the second dielectric layer over selected metal lines, parasitic capacitance between metal lines in adjacent metal layers (i.e. inter-layer capacitance) is advantageously reduced. Thus, in one embodiment, the present invention advantageously achieves an improved damascene interconnect structure that advantageously reduces inter-layer capacitance.

In contrast to the present invention as defined by amended independent claim 1, Buchwalter does not teach, disclose, or suggest forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, and etching one or more air trenches into damascene structure so that the air trenches are positioned over selected metal lines, wherein the one or more air trenches are not etched into the first dielectric layer and a first capping layer. Buchwalter specifically discloses forming dielectric layers 20 and 30 over substrate 10, etching trenches 50 in dielectric layer 30 and vias 40 in dielectric layer 20, filling trenches 50 and vias 40 with copper, and planarizing the structure to form a

dual level metal (DLM) comprising a wiring trace/stud structure in-laid in the dielectric. See, for example, column 6, lines 20-46 and Figures 2A through 2C of Buchwalter.

In Buchwalter, after additional polymer based DLM layers have been added, the wafer is etched in a plasma etch or reactive ion etch system such that polymer is removed from all areas not covered over by metal features. See, for example, column 6, lines 49-58 and Figure 4A of Buchwalter. In Buchwalter, by etching the polymer (i.e. dielectric layers 20 and 30) from all areas not covered by the metal features, air gaps 110 are formed. See, for example, Figure 4C and related text of Buchwalter. Thus, in Buchwalter, air gaps 110 are formed by etching into the dielectric layers in which wiring traces and vias are formed (i.e. dielectric layers 20 and 30). Thus, Buchwalter fails to teach, disclose, or remotely suggest forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, and etching one or more air trenches into damascene structure so that the air trenches are positioned over selected metal lines, wherein the one or more air trenches are not etched into the first dielectric layer and a first capping layer, as specified in amended independent claim 1.

For the foregoing reasons, Applicants respectfully submit that the present invention, as defined by amended independent claim 1, is not taught, disclosed, or suggested by Buchwalter. Thus, amended independent claim 1 is patentably distinguishable over Buchwalter. As such, claims 2-8 depending from amended independent claim 1 are, *a fortiori*, also patentably distinguishable over Buchwalter for at

least the reasons presented above and also for additional limitations contained in each dependent claim.

Amended independent claim 29 includes similar limitations as amended independent claim 1. Thus, for the reasons discussed above, Applicant respectfully submits that the present invention, as defined by amended independent claim 29, is not suggested, disclosed, or taught by Buchwalter. Thus claim 30 depending from amended independent claim 29 is, *a fortiori*, also patentably distinguishable over Buchwalter for at least the reasons presented above and also for additional limitations contained in the dependent claim.

B. Rejection of Claims 21-28 under 35 USC §103(a)

The Examiner has rejected claims 21-28 under 35 USC §103(a) as being unpatentable over Buchwalter in view of U.S. patent number 5,708,303 to Shin-Puu Jeng (hereinafter "Jeng"). For the reasons discussed below, Applicants respectfully submits that the present invention, as defined by amended independent claim 21, is patentably distinguishable over Buchwalter and Jeng, singly or in combination thereof.

The present invention, as defined by amended independent claim 21, recites, among other things, forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, and etching one or more air trenches into damascene structure so that the air trenches are positioned over selected metal lines, wherein the one or more air

trenches are not etched into the first dielectric layer and a first capping layer. The present invention, as defined by amended independent claim 21, provides similar advantages as the present invention as defined by amended independent claim 1 as discussed above.

As discussed above, Buchwalter fails to teach, disclose, or remotely suggest forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, and etching one or more air trenches into damascene structure so that the air trenches are positioned over selected metal lines, wherein the one or more air trenches are not etched into the first dielectric layer and a first capping layer.

In contrast to the present invention as defined by amended independent claim 21, Jeng does not teach, disclose, or suggest forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, and etching one or more air trenches into damascene structure so that the air trenches are positioned over selected metal lines, wherein the one or more air trenches are not etched into the first dielectric layer and a first capping layer. The Examiner has cited Jeng to disclose that it is well known in the art to deposit an etch stop layer directly on a polish stop layer. Page 8 of the Office Action dated November 18, 2004.

Jeng discloses that a device may have air gaps between closely spaced metal interconnects. See, for example, the Abstract of Jeng. However, Jeng fails to teach, disclose, or remotely suggest forming a plurality of trenches in a first capping layer and a

first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, and etching one or more air trenches into damascene structure so that the air trenches are positioned over selected metal lines, wherein the one or more air trenches are not etched into the first dielectric layer and a first capping layer, as specified in independent claim 21. Thus, Jeng fails to cure the basic deficiencies of Buchwalter discussed above. Thus, Applicants respectfully submit that the combination of Buchwalter and Jeng does not and cannot result in the claimed invention as defined by amended independent claim 21.

For the foregoing reasons, Applicants respectfully submit that the present invention, as defined by amended independent claim 21, is not taught, disclosed, or suggested by Buchwalter and Jeng, singly or in combination thereof. Thus, amended independent claim 21 is patentably distinguishable over Buchwalter and Jeng. As such, claims 22-28 depending from amended independent claim 21 are, *a fortiori*, also patentably distinguishable over Buchwalter and Jeng for at least the reasons presented above and also for additional limitations contained in each dependent claim.

C. Conclusion

Based on the foregoing reasons, the present invention, as defined by amended independent claims 1, 21, and 29, and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 1-8 and 21-30 pending in the present application are patentably distinguishable over the art cited by the Examiner.

As such, and for all the foregoing reasons, an early allowance of claims 1-8 and 21-30 pending in the present application is respectfully requested.

Attorney Docket No.: 02SPE130P

Respectfully Submitted,
FARJAMI & FARJAMI LLP

Date: 7/21/05

Michael Farjami, Esq.
Reg. No. 38,135

FARJAMI & FARJAMI LLP
26522 La Alameda Ave., Suite 360
Mission Viejo, California 92691
Telephone: (949) 282-1000
Facsimile: (949) 282-1002

CERTIFICATE OF FACSIMILE TRANSMISSION
I hereby certify that this correspondence is being filed by facsimile transmission to United States Patent and Trademark Office at facsimile number **571-273-8300** on the date stated below. The facsimile transmission report indicated that the facsimile transmission was successful.

Date of Facsimile: 7/21/05

Christina Carter
Name of Person Performing Facsimile Transmission

Christina Carter 7/21/05
Signature Date

CERTIFICATE OF MAILING
I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

Date of Deposit: _____

_____
Name of Person Mailing Paper and/or Fee

_____
Signature Date